mas County, Oreg. During the winter of 1889–90 I delivered several addresses at farmers' institutes, and during the following nine years made many such addresses, principally in the State of Oregon. In 1893–94 I delivered a lecture at Stanford University, Cal., one at the State University of California, and one at Santa Clara, Cal., in addition I made some four or five addresses of a more popular nature before the Normal School, High School, Academy of Sciences, &c., in San Francisco. The lectures at Stanford and at the State University were the first delivered at these places by a Weather Bureau official. For the lecture at the State University I had some 30 or 40 stereopticon slides made from daily weather maps, and these I used to illustrate my lecture; these slides are now used by the official in charge of the San Francisco office, for illustrated lecture work. From 1894 to 1900 I made many addresses in Oregon on the subject of The Weather Bureau and its Work. I have addressed the students of the State Agricultural College of Oregon on various occasions, the State Grange, the great summer Chatauqua meetings at Gladstone, Oreg., farmers' institutes, dairy meetings, horticultural meetings, State, county, and district fairs, stockmen's conventions, fishermens' conventions, miners' conventions, State medical conventions, Pacific Coast Dental Association, Fruit Growers' Union, chambers of commerce, boards of trade, and academies of science. These lectures covered a wide range, but all showed the direct effect which the Weather Bureau has upon all industries.

In addition to the foregoing I made a specialty of having classes from public schools, colleges, etc., visit the office at Portland, Oreg., when instruments were shown and the practical work of the Bureau thoroughly explained.

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I have at the present time several invitations to make addresses in this city, Detroit, Mich., three of which I shall now mention: One to be delivered as one of a course of lectures given in the auditorium of the Masonic Temple, under the auspices of the chapter masons, to masons and their friends; the second before the Unity Club of the Unitarian Church, being one of a course of lectures on various subjects under the general title The Progress and Development of the Century, my subject being Meteorology, and the third to be given before the teachers of the public schools in this city.

Mr. John R. Weeks, Observer Weather Bureau, writes from Fort Smith, Ark., saying that a series of lectures on meteorology and especially cloud forms, is being arranged for by Prof. J. E. Hallimen, instructor in physical geography at the high school. Mr. Weeks adds that this is the first year that such work has been undertaken in this city, and that this awakened interest in the work of the Bureau "has been without any suggestion or solicitation on my part, although it had been my intention to broach the matter as soon as opportunity offered."

Prof. H. J. Cox, in charge of the Chicago station, says:

In the three higher grades of the Chicago public schools instruction is given by the teachers each morning upon popular and elementary meteorology, and in the high schools, during the course, in physiography. Professor Salisbury, at the Chicago University, gives lectures upon meteorology and uses Professor Davis's meteorology as a textbook. J. Paul Goode also delivers lectures upon the subject at the university during each summer quarter. Other schools and private academies in this city give much attention to the subject, and during the entire instruction the daily weather maps are furnished by this office; sometimes, in special cases, as many as fifty per day have been furnished for a period of a week. These classes almost invariably come to this office for additional instruction, and it is not unusual, as often as once a week, for either myself or one of my assistants to give a lecture at the Weather Bureau upon the subject of forecasting, the movement of storms, and the working of the instruments, to these visiting classes. In fact, the demand for this instruction has been so great that it has been found necessary to curtail these visits to some extent, as they interfere with the office work.

For several years it has been the custom for the officials of the Chicago office to give lectures before various societies in this city. Last winter Mr. Linney delivered a lecture before the Chicago Geographic Society, and I gave an informal talk before a South Side school about the same time. I have accepted an invitation from the Chicago Academy of Science to deliver a lecture next January. Such work, while important in itself, can not well be extended without interfering with important Weather Bureau work. We give encouragement to those who desire to study the science, and we feel that there is great interest taken in the subject in this city.

I may say, in conclusion, that I was probably the first observer of the Weather Bureau who gave regular instruction and lectures upon meteorology at an institution of learning. During the years 1887 and 1888, while at Northfield, Vt., I was a member of the faculty of the Norwich University, and inaugurated a course in meteorology, which has been continued to the present day.

Mr. S. S. Bassler, Local Forecast Official at Cincinnati, reports that the schools in Cincinnati, now under the superintendence of Dr. R. G. Boone, are taking a lively interest in meteorology, in connection with "nature studies." He has prepared a short paper on this subject, to be read on December 4. He will also speak before the teachers of Bellevue, Ky., on December 14, 1900, and in Covington, Ky., in February, 1901.

Mr. W. M. Fulton, Observer in charge, Knoxville, Tenn., addressed the farmers' institutes at Rogersville, Tenn., in October, and again the institute at Newmarket, Tenn., on November 9 and 10.

TRAINING NEEDED TO BECOME INVESTIGATORS.

It is a very common mistake to think that education consists wholly in learning at school or college all that is worth knowing relative to the past achievements and present condition of knowledge. Those who have thus acquired eminent attainments in knowledge receive the college degrees of B. A. or M. A., and enter upon active life with far greater mental resources than those who have not been so highly privileged. Their knowledge stands them in good stead in both their social and business relations. But there is another much smaller class of students who desire, not merely to learn about all that is known but also to add to our knowledge. They propose not to be merely merchants or teachers, or popular writers and lecturers; they are not content with the field of applied science, but aspire to be original investigators, and to push forward the conquests of man over the hidden laws of nature. Every one must now recognize that the whole creation is an assemblage of problems in physics, and that we as yet know but little compared with what there is still to be found out. The inventions, and the arts that constitute our modern civilization, are but the inevitable application to human needs of the knowledge that the investigator has wrested from the secret chambers of nature. Those who contemplate becoming investigators in any field of science should, if any way possible, take the courses of instruction that are offered in most of our larger universities known as post graduate courses, and which usually lead to the degree of Doctor of Philosophy or Doctor of Science; these degrees should never be given as honorary titles. The importance and character of the training required for these degrees is enthusiastically described in the following article by Prof. Paul C. Freer of the University of Michigan, which we copy from the Michigan Alumnus for March, 1900, pp. 238–240:

A fundamental misconception of the meaning of research work is too often apparent. Untrained beginners are set at some hackneyed problem which involves little thought on their own part or on that of the proposer, and no knowledge of the general aspects of the subject; the results, even if the ultimate end is accomplished, being of little value to science as a whole—and yet these tyros are told that they are, and suppose themselves to be, engaged in original investigation. For this reason all competent workers should continually reiterate the fact that training of the most careful and conscientious kind, not only in the immediate subject of interest, but also in all of the branches related to it, must always precede any endeavor to enter into new and untried paths. The better the preliminary education the better the results, provided always that the worker has the proper capabilities and enthusiasm. If the impulse and spirit are lacking the attempt to do anything had better be abandoned. No good ever came from compulsion either from without or within.

True research does not occupy itself merely with the observation of a few details which of necessity suggest themselves in conjunction with any subject, but it must also connect the facts which it has estab-

lished with those observed by others, in such a way that the results will form a portion of the whole structure of science. In other words, the investigator must be able to generalize or do hack work. Without generalization there would be no sciences, and the present comity existing between kindred disciplines would be absent. Observations, however carefully carried out, are not research, and it is wrong to call the mere observer a research worker.

The logical result of the above argument is that the student, in order to accomplish anything as an original worker, must clearly realize the necessity, not only of a thorough understanding of his own subject and of the allied branches, but also the importance of a good substratum of general culture. The more a man has used his brain as an apparatus for thinking, the more he will be able to do in research. For this reason the undergraduate should not be too anxious to specialize. Let him, perhaps during his four years' course, obtain some insight into the underlying facts and theories of his chosen science, but, of all things, let him beware of neglecting the opportunity of familiarizing himself with the world which surrounds both him and the subject to which he intends to devote himself.

The undergraduate who really means to accomplish something, makes no greater mistake than to suppose himself able to do without graduate work. All beginners are dependent on their teachers, the advanced student should learn to depend upon himself, and this end can only be reached after the necessary preliminary routine is completed.

An undergraduate can not be expected to master the necessary details of a profession. He must and will be an amateur. If he really loves the subject he has chosen he certainly should be willing and anxious to prepare himself for further development by graduate study. Here, too, the brief time given to obtaining the master's degree is not sufficient for any valuable results in research; nor, indeed, if the student has properly used his time during the preliminary period of training, will he be prepared to properly launch himself in the higher fields of original investigation. He had far better devote the interval given to the intermediate degree to acquainting himself with the necessary details of his chosen subject, with its relations to other sciences and to gaining as good an insight as possible into its literature and history. In this way the worker will discover in what portion of the field an original investigation can be carried on, understand its relative importance, and comprehend the way in which it is related to the whole structure of which it is to form a part. A man so trained may do something worthy of the doctorate and also worthy of the vast field of scientific thought into which he has entered.

Above all, no one should strive to begin scientific work actuated solely by mercenary considerations. The question is too often asked: Where can I apply this to some practical end? How can I make money out of this subject? No more blighting influence to scientific development can be imagined. It deprives science of the very essence of its existence—the universal comity of knowledge—it changes that which might be for the good of all into something for the benefit of the individual pocketbook; it retards rather than accelerates growth. The history of each individual case is but a repetition of the universal history of science. A premature attempt to apply what he has acquired to practical ends simply results in robbing the student of his power for further development. It leaves him where he stands for all time to come, and his more studious brethren will soon pass and distance him, regardless of the fact that his immediate pecuniary gain may be greater.

The sciences of to-day form a body of great generalizations, none of which have come to us through the efforts of one man; they are, on the contrary, a result of gradual growth in each step of which the mental acumen of some investigator, perhaps long since dead, can be seen, and each research of to-day is built upon some perhaps equally great one of yesterday. Science is a stern mistress who gives of the best within her only to those who follow her unflinchingly, however difficult the task, however remote the prospect of pecuniary gain or of self-aggrandizement, their sole hope being that they, too, may add to mankind's knowledge of truth, so that future generations may profit by the sacrifices of the present. This has been the spirit of the past; it must also be the spirit of the present and of the future. Science is moving onward, swiftly, relentlessly, unflinchingly; no half-hearted followers for her; the weak fall by the wayside; there is no place for those who have not the patience to acquire the necessary knowledge. The strong press forward in fierce rivalry, each striving for the ultimate goal, a perfect human knowledge by which from any given premises the logical conclusion may be drawn with unerring accuracy.

CLIMATE AND FLORA.

Mr. Thomas H. Kearney, Jr., has published in Science a series of articles on the plant geography of North America. In that journal for November 30, Vol. XII, pp. 840–842, he gives expression to some of the "conditions of climate and soil which permit the actual existence of numerous lower austral forms in juxtaposition to a transition and even Canadian flora." He believes the factors that have the largest effect in determining the zonal distribution of organisms are (1) the normal number of days during the year which possess a temperature of the air above 6° C., or 43° F.; (2) the normal sum total of temperatures above 6° C.; (3) the normal mean of the six consecutive hottest weeks. The following table gives the values of this data for four stations in the mountain region and two of the most northern stations in the Austro-riparian area. The two additional factors of importance, permitting species to maintain themselves in what would seem to be an unfriendly environment, are (4) the amount of insolation as to duration and intensity; (5) the nature of the soil. As the items 1–4 are already computed for many Weather Bureau stations, it would seem possible to make an extended inquiry along the lines suggested by Mr. Kearney.

Stations.	Altitudes.	Days with temperature above 43° F.	Sum total above 43° F.	Normal mean of six hottest weeks.
	Feet.	*Days.*	° F.	° F.
Highlands, N. C.	3,817	234	3,547	66.1
Asheville, N. C.	1,981-2,250	249	4,688	71.3
Knoxville, Tenn.	891- 933	267	5,563	76.1
Valleyhead, Ala.	1,027	293	5,488	75.2
Norfolk, Va.	11- 12	295	6,047	79.3
Memphis, Tenn.	117- 273	307	6,754	81.0

HEAVIEST RAINFALL AT LA CROSSE, WIS.

Mr. R. H. Dean, Observer, Weather Bureau, at La Crosse, Wis., reports that the rainfall on the 27th and 28th exceeded all previous records for twenty-four hours at that station. He has compiled the following table, showing the amount and date of the greatest daily rainfalls in each month since 1871, inclusive. The record of 7.23 inches on October 27–28, 1900, occurred in twenty-two hours and eighteen minutes, between 10:12 a. m. of the 27th and 8:30 a. m. of the 28th:

	Inches.
January 28 and 29, 1891	1.32
February 27, 1876	1.10
March 27, 1880	2.05
April 27 and 28, 1889	1.66
May 14 and 15, 1900	1.90
June 11 and 12, 1899	4.91
July 14, 1900	4.12
August 7 and 8, 1889	4.25
September 6 and 7, 1884	5.69
October 29 and 30, 1896	2.41
October 27 and 28, 1900	7.23
November 10, 1880	1.74
December 24 and 25, 1895	2.11

METEOROLOGICAL CABLEGRAMS.

On page 248 of the MONTHLY WEATHER REVIEW for June, 1900, we have given in full the title of the Atlantic Cable Directory for the convenience of those who have occasion to transmit to the Weather Bureau meteorological information from foreign countries by cable or telegraph. As this work is no better known than several other systems of cable cipher, we append also the following titles of other works, and would say that any dispatch for the Weather Bureau may be sent in any system of cipher that is most convenient to the author, provided it has been published, with confidence that the Weather Bureau will be able to decipher it as all ordinary cable codes are at hand or available for this use. Among the codes most used in America and Europe are the following:

No. 1, The Atlantic Cable Directory, already referred to.

No. 2, Western Union Telegraphic Code and International Cable Directory, compiled and published by the International